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# DRIVING FORCES FOR M-COMMERCE SUCCESS

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# Driving Forces for M-commerce Success

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**Abstract:**
Is m-commerce just an extension or a subset of e-commerce? Will it turn out to be just more hype? In this paper we discuss the realities of m-commerce and the major differences between mobile commerce and Internet-based e-commerce. Based on this understanding, we identify key factors that must be taken into consideration in order to design valuable m-commerce applications. We emphasize that the success of m-commerce relies on the synergy of three driving forces: technology innovation, evolution of a new value chain, and active customer demand.

**Key words:**
m-commerce, e-commerce, wireless communication networks

## 1. Introduction

What is mobile commerce? Is it just hype? Almost every company in telecommunications is trying to figure out what m-commerce really is and to exploit it. From the marketers' vision, in the new world presented by m-commerce, consumers can use their cell phones and other wireless devices to purchase goods and services just as they would over the Internet using their personal computers (PCs). Specifically, m-commerce is about content delivery (notification and reporting) and transactions (purchasing and data entry) on mobile devices (Leung and Antypas, 2001). Unfortunately, in reality, m-commerce is often a highly frustrating experience. Industry observers attribute this drawback to the immaturity of mobile technology, but they believe 3G (third generation wireless digital cellular telephone technology) networks could change the situation (Cohn, 2001). While m-commerce is still in its infancy, enhanced devices and networks are irrelevant unless m-commerce applications are compelling and user friendly.

Most often m-commerce is understood as mobile e-commerce (Donegan, 2000; Schwartz, 2000; Liebmann, 2000). M-commerce is supposed to enable us to buy everything from anywhere over the Internet without the use of a PC. Internet access and Web browsing is assumed to be the key to extending m-commerce to customers (Harter, 2000). In many ways, m-commerce is the continuation of e-commerce with the palm handheld, wireless laptops and a new generation of Web-enabled digital phones already on the market (Keen, 2001). Thus it was once believed that if you brought together mobile communications and the Internet, two of the biggest things in telecommunications, there would be an almighty explosion of growth. However, it has not happened yet. In many ways, m-commerce and the wireless Internet have been the victims of over-excited speculation (Darling, 2001). Among 1,700 people surveyed in Spring 2000 by *Jupiter*

*Communications*, the majority said that they would not use or pay for the wireless Web (Lindsay, 2000). Only 10% said they would make retail purchases on the wireless Web. According to a study conducted in Fall 2000 in London by the *Nielsen Norman Group*, 70% of the WAP (Wireless Application Protocol) service participants said that they would definitely not want to use a WAP phone again within one year (Schultz, 2001). One in four owners of mobile devices stopped using wireless web applications after the first few attempts, according to a recent report from the *Boston Consulting Group* (Goldman, 2001). WAP services were disappointing, particularly in Northern Europe countries, where mobile communications are most advanced and consumers know well the limitations of the wireless Web (Monica, 2000). Consequently, the enthusiasm that originally greeted the concept of the mobile Internet has waned.

Contrary to conventional perspectives on m-commerce, forward-thinking marketers should not view m-commerce as e-commerce with limitations, but rather as wireless in its own unique medium, with its own unique benefits (Cotlier, 2000). Even though wireless technology is sometimes regarded as an enhancement tool rather than a brand new medium (Ramakrishnan, 2001), successful players in the m-commerce market space must take a much broader view of the technology, the market, and potential consumers. M-commerce is not simply a new distribution channel, a mobile Internet or a substitute for PCs. Rather, it is a new aspect of consumerism and a much more powerful way to communicate with customers. Obviously, people will not shop with their phones in the same way they shop with PCs. Unleashing the value of m-commerce requires understanding the role that mobility plays in people's lives today. That calls for a radical shift in thinking (Nohria and Leestma 2001).

In this paper, we will identify driving forces for the success of m-commerce. To clarify the nature of m-commerce, we discuss several fundamental differences between m-commerce and Internet-based e-commerce. Based on this new perspective of m-commerce, we identify a set of key factors that should be considered by marketers as well as consumers in making decisions concerning m-commerce applications. Finally, we propose that the synergy of three driving forces will lead to a greater likelihood of success for m-commerce.

## 2. Key differences between m-commerce and e-commerce

As we argued, m-commerce is not simply an extension or a subset of e-commerce. In fact, there exist fundamental differences between m-commerce and e-commerce in terms of their origins, technologies and the nature of the services they can offer.

### 2.1 Origin

The emergence and development of e-commerce was due to the rapid growth of the Internet. The Internet originated from several U.S. government programs (ARPANET, CSNET and NSFNET, etc) aimed at providing a networked computing environment for researchers (Kalakota and Whinston, 1996). Milestones in Internet development reflect a history of government-sponsored initiatives. Starting from the early 1990s, the Internet was extended to business community applications. With such great business potential and

rapid growth to millions of users, the term "electronic commerce" was coined, and e-commerce applications expanded rapidly (Turban et al., 1999). Because of widely-expanding networks and nearly free access to the Internet, e-commerce bridges distances and enables companies to display and sell goods and services cheaply to consumers and businesses around the world. No company really owns the Internet. In the Internet world, much is given away free or at a discount in the hope that a way will eventually be found (presumably through advertising income) to turn traffic into profits.

Contrarily, m-commerce is rooted in paid-for service in the private mobile phone industry where business competition is stiff. In the telecom world, users pay for airtime, by the size of the data packet transmitted, and by the service used for what they get (Fox, 2000). Global wireless networks are segmented and owned by different mobile operators such as *AT&T, Pacific Bell Wireless, Vodafone, Orange, Deutsche, NTT DoCoMo*, etc. Compared to almost free Internet access, high cost has been seen as a major characteristic of m-commerce (Shim and Rice, 2001). Mobile communication through cell phones is costly, and any additional services will attract extra charges. The reason is that establishing a mobile communication network requires heavy business investment with no government support. To implement the new broadband digital wireless communication networks to support 2.5G and 3G services requires massive expenditures. Investors implementing 3G have to face the high cost of market entry (bidding for government licenses of the required radio frequency spectra) (Ramakrishnan, 2001). M-commerce carriers therefore must look for a great deal of business activity to generate revenues that justify the huge infrastructure investments. In the case of m-commerce, although marketing professionals speak of rolling out a 4Ps (product, price, promotion, and place) marketing strategy, price marketing is by far the most important of the four in terms of creating m-commerce value (Lamont, 2001). Instead of enticing massive user populations through cheap network connections as in the case of e-commerce, marketers must now educate customers who prefer professional services to adjust to substantially higher fees, including paying for content.

Due to their different origins, the customer bases of m-commerce and e-commerce are quite different. Scientists and researchers originated the Internet in the United States, so most Internet users still are highly educated: 80.9 percent have at least some college education, and 50.1 percent have at least a bachelor's degree (Turban et al., 1999). In contrast, besides business users, most cell phone users are young people or relatively less well-educated consumers. Over the next decade, billions of people will gain access to mobile devices, but many of them will be functionally illiterate and technologically unsophisticated users (Feldman, 2000). In total, upwards of 300 million people -- more than the population of PC owners -- across the world subscribe to mobile phones. And it is forecasted that this figure will pass one billion by 2003. Mobile telephones will be as common as television sets (Barnett et al. 2000). Because of the difference in origin, consumers have quite different expectations about m-commerce and e-commerce. For example, one reason for the low uptake of the wireless Internet in the U.S is that most Americans already are familiar with the wired Internet and expect to pay for wireless Internet access as they do for the wired one: unlimited access for a flat monthly fee (Fox, 2000).

## 2.2 Technology

The Internet, the fundamental infrastructure of e-commerce, adopted a well-established protocol, TCP/IP (Transmission Control Protocol/Internet Protocol), which solves the global internetworking problem and ensures that computers communicate with one another in a reliable fashion. A particular computer on the Internet can be identified and accessed either explicitly through a unique IP address or implicitly through a URL with a domain name like www.yahoo.com. Over the past several years, the World Wide Web (WWW) has come to dominate Internet traffic, and the vast majority of e-commerce applications are Web-based. The Universal Resource Locator (URL) and the Hyper Text Transport Protocol (HTTP) were introduced to fulfill the need to locate a network resource and to communicate among Web browsers and Web servers. It is also easy to connect the Internet with existing business information systems. Uniform Internet standards significantly reduced e-commerce entry costs and helped fuel the rapid growth of e-commerce.

In contrast, m-commerce services are constrained by a variety of wireless media communication standards ranging from global (Satellite), regional (3G, IEEE 802.11a/b, DoCoMo I-mode), to short distance (Bluetooth) (Shim and Rice, 2001). Just as modem designers battled over compatibility issues in the early 1990s, cellular carriers now use different systems and standards that do not work together (particularly in North America). Today, three systems -- GSM (Global Service for Mobile), TDMA (Time Division Multiple Access), and CDMA (Code Division Multiple Access) -- are provided by different carriers who compete with each other (Leung and Antypas, 2001). M-commerce applications tend to be device and carrier dependent. The wireless devices available today primarily use two technologies: WAP and SMS. WAP (Wireless Application Protocol) is the display language designed for cellular handsets. It was rcreated by *Motorola, Ericsson, Nokia* and *Phone.com* in 1997 when they founded the WAP Forum. WAP is a derivative of the XML/HTML language family, but it is designed to operate without a keyboard or mouse. SMS (Short Message Systems/Services) is a derivative of the old numeric paging network, with additional functionality for two-way communication and support for text and attachments. There are more users of SMS today than of WAP, thanks to cheaper service and the widespread availability of low-cost, two-way paging devices from companies such as *Motorola* (Leung and Antypas, 2001).

Till now, there has been no generic world-wide framework and standard for application development using universal mobile connection and access. In fact, wireless technology is still in its infancy and hindered by limited coverage and a smorgasbord of competing standards, which can explain the slower-than-expected adoption of m-commerce in the United States (Shim and Rice, 2001). Choosing from conflicting standards, products and features gives even hardened technophiles a headache. The pyramid of m-commerce applications thereby presents a much more complicated process, in which many pieces must fall into place before the mobile phone can be seen as a real revenue generator (http://www. alliedworld.com).

In addition to underlying networking infrastructure and standards, it is the client devices that actually determine what specific services can be delivered. The boom in e-commerce applications is actually due to the wide use of PCs, which have a complete text input keyboard, large screen, substantial memory, and high processing power. Contrarily, various m-commerce applications rely on the use of handheld devices. These devices range from pagers, cell phones, palms, to pocket PCs. Mobile devices such as cell phones and PDAs (Personal Digital Assistants) have tiny screens, some of which display only three lines of text at once (Lucas, 2001). The displays are black and white with low resolution; there are no QWERTY keyboards, and no support for animation (Leung and Antypas, 2001). Although WAP devices support a limited graphics format called Wbitmap, because mobile devices have limited bandwidth and small screens, any application that is heavily graphic or animation driven would not be suitable at this time. In addition, software applications are relatively crude. There are no cookies or session controls, meaning that if the connection is lost, the application will restart rather than continue from previous screens (Leung and Antypas, 2001). Web browsers and drop-down menus are unavailable, so companies must plan on character-based terminal applications with cursors and entry forms. Long selection lists or deep menu layers will wear out the fingers of even the most patient users. In 2000, most smart cards used in cell phones held only 32K of memory (Moustafa, 2000). In fact, among these devices, mobile phones are still regarded as the primary device for various m-commerce tasks (Jainschigg and Grigonis 2001). However, in contrast to PCs, cell phones do have their own unique features: mobile, portable (small size), smooth voice communication, and connected to persons (primarily because of portability) rather than to home or office.

### 2.3 The Nature of Services

The wide accessibility of the Internet makes any e-commerce service globally available. The World-Wide Web enables search and delivery of rich information, and sophisticated electronic transaction processes can be easily integrated with backend enterprise information systems. In contrast, the delivery of m-commerce applications relies on private wireless communication carriers. These services are usually delivered to a specific region, and are rather simple, more personalized, location-specific and time-sensitive. Since a mobile device usually accompanies a person wherever he or she goes, mobile services can be delivered to a person anywhere and anytime rather than to a fixed office or home. M-commerce therefore creates more of a perception of enhanced intimacy with consumers than other office-based distribution channels. Time sensitive, simple transactions such as movie ticket purchases, banking, and travel reservations are believed to be the key applications that will stimulate m-commerce (Lucas, 2001; Swartz, 2001). Other key drivers to m-commerce growth are location-based applications such as traveler navigation, emergency response, etc. (Secker, 2001; Rockhold, 2001; Swartz, 2001-1). The details of m-commerce applications will be discussed in the next section.
The major differences between m-commerce and e-commerce are summarized in Table 1.

**Table 1. Major Differences Between M-commerce and E-commerce**

| | E-commerce | M-commerce |
|---|---|---|

| | | |
|---|---|---|
| **ORIGIN** | | |
| Sponsorship | Government-sponsored Internet | Private mobile phone industry |
| Business entry cost | Low | High |
| Customer access cost | Free or low cost Internet access | High mobile service charge |
| Customer base | Highly educated computer users | Less educated cell phone customers |
| **TECHNOLOGY** | | |
| Message transmission | Packet-switched data transmission | Circuit switched for streamlined voice communication |
| Protocol | TCP/IP, HTTPML | GSM, TDMA, CDMA, 3G |
| Standardization | Highly standardized | Multiple incompatible standards |
| Connectivity | Global | Mainly regional |
| Bandwidth | High | Low |
| Identity | URL with IP and domain name | Phone number |
| Application development | General computer applications | Device-specific applications |
| Interface device | Personal computers | Cell phones and PDAs |
| Mobility | Fixed location | Mobile |
| Display | Big screen | Small screen |
| Main input mode | Keyboard for full text input | Voice with small key pad |
| Main output mode | Text and graphics | Voice with small text display |
| Local processing power | Powerful CPU with large memory and disk space | Limited processing power with small memory chip |
| Software and Programming | Support a variety of programming languages | Java or specific script languages |
| Trend | Towards sophistication | Towards minimization |
| **SERVICES** | | |
| Service range | Global | Regional |
| Delivery destination | PC in office connected to the Internet | Person accompanied by a mobile device |
| Transaction complexity | Complete and complex transactions | Simple transactions |
| Information provided | Rich information | Simple and short messages |

| Timing | Less time-critical | Time critical |
|---|---|---|
| Location-based service | No | Yes |
| Target mobility | Service to a fixed point | Service to a moving target |
| Backend business connection | Strong connection to backend business information systems | Weak connection to backend business information systems |

## 3. Key Factors in Designing M-Commerce Applications

Once we have identified the major differences between wireless mobile communication based m-commerce and Internet based e-commerce, we can identify the key factors that must be taken into consideration in designing useful m-commerce applications.

### 3.1 Mobility

M-commerce opportunities can be very significant, if investors understand consumer groups intimately and develop ubiquitous solutions that recognize the role that mobility plays in consumers' lives (Nohria and Leestma, 2001). In business services, not being forced to be hardwired enables a company's employees to remain connected while moving from office to office, or state to state; they can tap into the corporate network from airport lounges and hotel lobbies. For individual consumers, mobile devices basically allow them to keep in touch with their friends and families anywhere and anytime. Beyond this mobile communication, additional value can be generated by linking mobile consumers and existing services. Generally, mobile consumers can access various services anytime and anywhere, presenting new marketing channels for businesses. For instance, videophone users can take pictures wherever they go and send them attached with short notes to friends while shopping, traveling, or simply hanging out (Kunii, 2001). While traveling, a user may also use a mobile phone to control a home burglar or fire alarm system and to turn lights on or off as if at home (Fox, 2000).

### 3.2 Personal identity and built in payment mechanism

Since mobile devices, particularly cell phones, are registered by their subscribers and normally accompany the person, it becomes possible to identify and deliver personalized services to the user. A cell phone with additional security information such as a PIN number or biometric identification technology can be used to identify a person. A payment mechanism may also be built into the cell phone system. It is then possible to allow consumers to use their wireless phones as devices to make or trigger a payment (bus ticket, vendor machine etc.), similar to the use of a smart card or an ATM machine. And there are even a few vending machines that let users pay for soft drinks using their cell phones (Fox, 2000). Credit card numbers could also be replaced by cellular phone numbers for wireless transactions. Relying on a third party payment mechanism is always a big hurdle for Internet-based e-commerce because an IP address cannot identify a person. However, this difficulty could be easy to overcome in m-commerce with the use of an identifiable mobile device. Hence, cell phones naturally support e-Wallet applications in m-commerce, which is crucial to the success of other applications. Certainly, systematic security solutions involving PKI (Public Key Infrastructure) and biometric services should be adopted as well (Young, 2001). As an example *Obongo*, like

other providers of e-wallet applications, has modified its software for use on wireless devices. These so-called m-wallets are usually stored on a secure server at the cardholder's issuing bank or by the application provider on behalf of the card issuer. The wallet contains the cardholder's account data, name, and mailing address, and is accessed with the push of a button. Once opened, the data within the wallet are transferred to the merchant to complete the payment (Lucas, 2001). M-wallets make micro-payments easier and help carriers charge for advanced services such as digital media and game applications that consumers cannot get any other way (Swartz, 2001-2).

Besides financial services, personalization in m-commerce can migrate into entertainment (music and games, etc), content services and even personalized marketing. Since mobile operators maintain personal information on subscribers, a CD vendor, for example, could simply ask customers to verify payment information and a shipping address through their cell phone displays rather than have them fill out forms each time from scratch (Barnett, et al. 2000). Good potential applications of the content revolution are personalized software that deliver highly targeted offers for large-or-small-ticket items that consumers can act upon, even while waiting in line (Lucas, 2001).

### 3.3 Location-Based Services

To date mobile-location services have been regarded as key enablers of m-commerce's future success, according to current hype (Swartz, 2001-1). Portable geographic positioning systems (GPS) are becoming smaller and more affordable, at costs in the neighborhood of only about U.S. $200. These systems can be used not only to identify location information, but also for business to deliver location-sensitive services to users. The ability to target rich and relevant information to end-users provides great potential value in location-based applications. For instance, it would be quite useful to provide driving directions and local commercial services where users happen to be, such as near specific restaurants, movie shows, bus schedules, weather reports and guided tours in museums (Shaffer, 2000; Taaffe, 2001). Hence, one of the selling points of m-commerce applications is proximity. *Go2Systems*, in Irvine, Calif., one of a swarm of vendors eyeing the uses of ALI (automatic location identification) data, linked with *Coca-Cola* to steer wireless customers to stores selling *Coke* products (Jones, 2000). *Coca-Cola*, the world's best-known brand, has ventured into the wireless world by providing its fountain clients (*McDonalds*, *Burger King* and more than 800,000 U.S. restaurants) with the opportunity to attract additional business by placing their names on *Go2 Systems'* wireless services. The 5-year, U.S. $30-million deal will allow customers to find the nearest *Coke* fountain location through their cellular phones with *Go2* location-based direction services, which include addresses, turn-by-turn directions and one-click calling (Swartz, 2001-1). *CT Motion*, a location-based services developer, provides an m-coupon application, by which the mobile user can receive an electronic coupon from a retailer in his specific location (Secker, 2001). Imagine that a young teenager is riding his skateboard through the park on a Saturday afternoon, when his cell phone beeps. It is a message from the *Soda X* portal that the local professional soccer team is playing tonight, and the store that he is approaching is offering him half-price tickets for the game if he buys a pair of jeans today.

Privacy concerns are critically important while implementing location-based advertising. Pull mode may resolve the issue of privacy, when a mobile user requests information and is willing to receive an advertisement (Secker, 2001). However, many location-based applications are still to be developed; few carriers have a strategy, let alone a business model (Swartz, 2001-1). Location-based services would have to be targeted extremely well, in order to avoid damaging trusted relationships that merchants already have with customers.

Location can be traced not only for people but also for other objects. *Cellpoint*, a supplier of location-based services (LBS) software, provides the applications used to track remote assets such as fleet vehicles and construction equipment, and also provides telematics products that allow remote machine-to-machine communications (Secker, 2001). It is also possible to trace a stolen car or a missing child that is carrying a specially designed radio device.

### 3.4 Time-critical impulse purchasing

Mobile phones are carried by their owners almost everywhere and kept switched on most of the time, especially in Europe, where mobile users are not charged for incoming calls. Consumers can thus not only gain access to wireless services wherever there is a network presence but also keep tabs on time-critical information such as stock market reports or urgent messages. Time-sensitive and simple transactions are another key to stimulate m-commerce. For some applications of m-commerce such as scanning news or purchasing books or other retail items, real-time transactions are not necessary. Nonetheless, there is a great deal of value in being able to monitor dynamic information through wireless handheld devices, such as aircraft flight status, shipping status, seat reservations or stock prices, and to alert the user when the information is updated (Shaffer, 2000; Schwartz, 2000; Leung and Antypas, 2001). There will be even more value in emergency situations such as medical care, traffic accidents, emergency road service, and crime reporting. Particularly with the mandatory ALI (automatic location identification) data supplied by a few key vendors such as *Xypoint*, U.S government emergency systems like E911 (Enhanced 911) were improved (Jones, 2000). The United States' FCC (Federal Communications Commission) mandates that the location of wireless callers be identified during a 911 emergency call. The *MapInfo*® (www.mapinfo.com) Location Management Platform (LMP) is used to enhance a carrier's 911 service by automatically routing 911 calls to an appropriate Public Safety Answering Point (PSAP) for handling and dispatch.

*Jupiter Research* indicated the desire for instant gratification is driving the $22 million in transactions via wireless in 2001 (Prior, 2001). Giving users access to information they need and when they need it is the biggest opportunity. Wireless directory assistance and enhanced directory assistance will support more than 10 billion calls and $7.5 billion in annual revenue by 2005. It will probably be a $20 billion industry where merchants pay to have premier placement and listings, since usually consumers are looking for a phone number or a particular merchant name while they are on the road. Today, the only option is to call 411, costing the user .75 to $1 (Swartz, 2001-2).

### 3.5 Special Market Niches

Mass-market consumers will be the really big users of m-commerce applications. And the customer base is large enough for potential revenue in the medium to long term (Sweeney, 2001). A single killer application would not work for everybody and there is going to be a whole set of niche applications that are relevant to each target audience. The mobile industry believes that location- based service advertising will have stimulated m-commerce so much that operators would eventually offer free phone charges to subscribers who are prepared to have advertising on their screens on a permanent basis. In particular, youth has a very powerful influence on this market (Secker, 2001). Actually, young people have been a major target of various m-commerce applications, particularly SMS and DoCoMo iMode services (Herman, 2000). Besides focusing on youth, mobile operators also suggest marketing future mobile data technology much more aggressively to business users (Parsons, 2000). In any case, for new m-commerce opportunities, carriers should be cautious about implementingly applications that require changes in consumer behavior. If many technology hurdles are to be overcome, along with a corresponding unreasonable change in behavior, the application is unlikely to succeed. Additionally, as we discussed above, price marketing is by far the most important in creating m-commerce value. Mobile carriers therefore need to develop unique offerings for each target market segment or services targeted, according to geographical location and demographics (Schneiderman, 2001). Learning about and analyzing customer psychology, and taking marketer perspectives would help carriers segment the mass-market and target specific to m-commerce applications.

We actually need to shift our way of thinking to exploit the uniqueness of m-commerce applications that can be brought to bear in our lives, rather than to be confined to thinking within the limitations of mobile devices. The factors that need to be considered for m-commerce applications are summarized in Table 2.

**Table 2. Key Design Factors and Typical Applications**

| Factors | Typical Applications |
|---|---|
| Mobility | ▪ Mobile communications (for business and personal contacts)<br>▪ Scheduling and coordination (: e.g. appointment arrangements, reminders, teleconferencing, etc.) |
| Location-sensitive | ▪ Travel navigation (driving or walking directions)<br>▪ Local tours (exhibitions, shopping malls, etc)<br>▪ Locating local services (restaurants, gas stations, etc)<br>▪ Locating moving objects (missing children, stolen cars, etc) |
| Time-critical | ▪ Short Message Services (SMS)<br>▪ Time-critical information (flight schedules, weather |

| | |
|---|---|
| | reports, traffic information, stock prices)<br>▪ Emergency services (medical care, accident and rescue services, crime stoppers) |
| Personal identity | ▪ Personal identification (secure entrance with biometrics check)<br>▪ Electronic payments (e-Wallet)<br>▪ Personalized location-aware advertisement<br>▪ Language-specific services (automatically switch to or translate to desired language) |
| Special market niche-targeted | ▪ Demographic segmentation (oriented to young people or business people).<br>▪ Country segmentation (tailored to specific country) |

## 4. Synergy of Three Driving Forces

E-commerce is being fueled by economic forces, customer interaction forces, and technology-driven digital convergence. Likewise, for m-commerce growth we identify three major forces that impel its growth: technology innovation, evolution of new value chains, and active customer demand. We propose that the synergy of these three forces will eventually lead to the success of m-commerce applications.

### 4.1 Technology Innovation

Technological progress is likely to bring about some novel applications for m-commerce. Here we identify several major technologies, improvements in which are expected to have a significant influence on m-commerce. The primary concern is with the capabilities of handsets, the fundamentals of mobile networks, the accuracy of geographic location information, and security solutions.

(1) Handsets

Low-cost, truly pervasive devices that present multi-modal information and perform transactions naturally can dramatically change what many people do and how they do it (Feldman, 2000). In the next several years, wireless devices will improve in interface design and information presentation. In countries like China and Japan, where the written language has never fit well with a Western keyboard, hand-helds that employ handwriting or speech recognition seem ideal (Herman, 2000). Wireless keypad mnemonics can also make the entry of data easier for consumers (Young, 2001).

Subscriber identity modules (SIMs) may take over due to their competitive advantage over voice or keystroke activation (Chanay, 2001). Newer devices will use expandable color screens capable of displaying up to 12 lines of text, more user-friendly keypads, and higher communication bandwidth (Lucas, 2001). Smart card memory capacity will reach

1MB by 2005. The processing capability of smart cards has increased and has given users the ability to enjoy more computationally intensive, high-value, transaction-based operations that require such features as digital signing and encryption (Moustafa, 2000). For those who crave the cutting edge, there are *DoCoMo*'s (in Japan) impressive third-generation handsets, which can capture and sends high-quality color movies almost in real time (Kunii, 2001). By using a *DoCoMo* camera-phone, it is possible to imagine being in a store shopping for a gift for a child and calling your spouse to show her what you are thinking of buying.

Besides improvements in user interfaces, applications and underlying middleware configurations will allow for interactions to switch communication modes smoothly without losing clarity or the thread of conversation. The Java Card Forum has developed specifications for implementing Java on smart cards. Support of Java on SIMs will allow wireless terminals to reach the Java developer community, simplifying the development of new services (Carrara, 2000). Overall, next-generation devices are expected to combine the functions of Personal Digital Assistants or PDAs (data exchange) and cell phones (verbal communication).

(2) Network infrastructure

The current (second) generation of wireless networks and handsets supports data rates of only 9.6 kilobits per second, far below the 64 Kbps capabilities of landline copper wires. GSM (Global System for Mobile Communication), the most common cellular standard, is being extended by the GPRS (General Packet Radio System), which can support data rates of 112 Kbps, almost twice the rate of a standard computer modem and enough to support high-quality streaming audio. True third-generation (3G) networks, based on the UMTS (Universal Mobile Telephone System) standard, are predicted to raise the maximum rate to 2 Mbps -- one-fifth of the bandwidth available on the standard Ethernet in today's offices (Barnett et al. 2000).

As promising network standards, 2G and 3G wireless technologies are still on the horizon. The 3G revolution is characterized by a shift from narrowband services, supplied by cellular systems such as GSM and GPRS, to broadband multimedia services with rates of up to 2Mbps per subscriber (Junowicz, 2001). According to *Ovum*, 3G will first take hold in Asia and Europe, with the rest of the world trailing a year or two behind (Fitchard, 2001). Currently, the leader in the field is Japan's existing second-generation, or 2G, digital networks that provide always-on connections for data transmission and support a wide range of online services - from news, weather, and ticket-booking to downloads of games and ring tones (Kunii, 2001).

Hybrid elements of 2G, 2.5G and 3G may be in play simultaneously on a wireless operator's infrastructure. Networks will be faced with a number of billing alternatives: charging per byte, by frequency of access, by location or by traditional subscription-based models (Hooper, 2001). A billing infrastructure should accommodate these approaches to ensure that applications are charged under the same parameters - volume, duration, destination, and event or application value, no matter what network is used.

Bluetooth is a short-distance, radio-based, point-to-point technology that, theoretically, can go up to 1 Mbps, and has already entered the market (Herman, 2000). It will be very useful for enabling location-based applications. It allows a wireless device to exchange data with PCs, laptop computers, point-of-sale devices and other wired devices without being physically connected by wires or adapters. Bluetooth is supported by more than 1,400 telecommunications and technology companies, including *Motorola, Intel*, and *Lucent Technologies* (Lucas, 2001).

(3) Geographic location technology

Location-based personalized services have been heavily touted as a major application for m-commerce. In order to deliver such services, mobile devices (particularly cell phones) should be able to keep track of an individual's physical location as he or she moves about. Some companies are focusing on underlying technologies or services such as radio-based methods for determining where users are calling from, or software and systems that blend location data with other information (Shaffer, 2000). The FCC (Federal Trade Commission) has stringent requirements for location services, in which carriers have to offer network-based systems that deliver location information with an accuracy of 300 meters for 95% of calls and 100 meters for 67% of calls (Brewin, 2001). For instance, an FCC ruling requires all wireless carriers to find a way to pinpoint the location of the users dialing 911 emergency services. Although the requirements are meeting resistance from various carriers that say they cannot reach that level of accuracy or at least need more time to do so, some can meet the requirements with the portion of their networks that uses the GSM (Global System for Mobile Communications) standard.

(4) Security technology

The lack of security is said to be one of largest barriers in delaying m-commerce implementation. In particular, security is a vital issue that affects the use of mobile technology in financial services, when account details and other confidential information move across the networks (Dezoysa, 2001-2). With regard to securing transactions, PKI (public key infrastructure) is believed to be the best method to secure end-to-end transactions (Moustafa, 2000). Besides securing wireless transactions from the cell phone to the m-commerce provider, the phone must also be secured from fraudulent use. Traditionally, the SIM (Subscriber Identity Module) card that stores the subscriber's account information is used for identifying and authenticating the subscriber to the network. A SIM card holds the subscriber's ID number, security information and has memory for a personal directory of phone numbers. One advantage of using SIMs versus a software approach is portability and independence from the terminal, since a user can move the SIM from one wireless terminal to another. This allows easy introduction of new applications without requiring any terminal modifications. There are industry standards for SIMs used in digital wireless phones that help ensure that all SIM-based terminals can support any SIM applications and services a provider develops (Carrara, 2000). Dual chip phones even have an additional SIM-size slot for an independent multi-application chip card targeted at payment, such as a bank-issued WIM card (wireless identification module) or EMV card (a payment standard defined by *Europay*, *Mastercard*, and *Visa International*) and other banking solution applications (Dezoysa, 2001-2).

The smart card started its life as a security device. In the near future, wireless biometric services will emerge as a common solution (Young, 2001). A biometric is a unique physical or behavioral characteristic of the human body, which may be checked automatically. The absolute verification of a user makes biometrics the highest security level. Biometrics comes in many forms. In 2000, fingerprints were the most widely used biometric, accounting for 50% of the market, followed by hand geometry (15%), face recognition (12%), voice recognition (10%), handwritten signature recognition (8%), and iris scan (4%) (Biometric Industry Report, 2001). In recent years, biometrics have gone digital, and modern electronic systems are capable of distilling the arches, loops and whorls of conventional fingerprints into a numerical code. As an example, *Champion Technology*, a Hong Kong company, has launched a fingerprint recognition system, which takes only a few seconds to accomplish recognition (Leary, 2001). Biometric authentication offers some promise of strong and convenient security for cell phones, in which the subscriber's signature or fingerprint can be thought of (mathematically) as a large random number (Crowe, 2001). These are easy for the owner to present to a machine but difficult for others to fake, and they cannot be lost, stolen or borrowed.

Further threats to security and privacy arise from malicious code that penetrates mobile networks. These can undermine security technologies such as signing technology and encryption that are resident on mobile devices (Ghosh, 2001). Information can be stolen or altered without the knowledge of the user, and networks can be compromised to the point that they fail. In mobile networks, devices roam from one zone to another, with the potential of transferring malicious code picked up from an untrustworthy zone to a trustworthy zone.

The growing m-commerce industry eventually will settle on a set of solutions to all of the different security problems, building end-to-end solutions that are secure, cost effective and easy for consumers to use. However, successfully implementing good quality solutions relies upon the acceptance of standards (either de facto or negotiated) within the highly interdependent functions of this industry.

**4.2 Value Chain Evolution**

As we discussed above, m-commerce is primarily rooted in the cash-rich mobile phone industry. Therefore, equipment vendors and network operators have been dominant in the m-commerce world. And in some sense, the mobile operators own virtually all of the value chains (Donegan, 2000). Unfortunately, this operator-dominated value chain is not able to successfully deliver flawlessly integrated personalized services for mobile phone users, which is crucial to the success of m-commerce (Swartz, 2001-2).

In theory, mobile operators could compete at all levels of the m-commerce value chain, from the provision of basic technical services to the supply of lucrative, customer-facing content, but this is simply not possible, since this will spread their skills and resources too thin. This has been abundantly demonstrated in the e-commerce marketplace, where different companies tend to invest and to focus on their specific expertise at particular levels of the value chain. There are some exceptions, where dominant companies such as

Microsoft and General Electric attempt to extend their reach vertically. Companies normally should concentrate on areas in which they naturally hold a competitive advantage. In m-commerce, mobile communication operators thus need to make difficult decisions about which parts of the value chain to compete in – and how - and which parts to avoid. There are many critical roles that they may be able to play and a number of business models that may be suitable in these roles (Tsalgatidou and Pitoura, 2001).

Some mobile data industry observers believe that, although Europe has a more advanced mobile communication infrastructure, the European approach to the m-commerce market will fail (Darling, 2001). They suggest that many European service providers want to own the customers and to support all the applications that customers want to perform. Some mobile operators may even want to become banks or content providers in their own right but, even though carriers have all the critical capabilities in place, including location, shopping, e-wallets, promotion and personalization, without partnerships with knowledgeable merchants and intermediaries, prospective customers will have nothing to access. Therefore, partnerships between m-commerce providers, interested content providers, and other businesses are critical to the success of m-commerce.

Providing complex data services is a very different business from running a voice network, so carriers have to choose partners to provide content, and decide which services to offer their customers. In pursuing value-added services, more entrepreneurial companies have the products and capability to get them integrated and delivered to handsets (Goldman, 2000). Also, since capitalizing on the promise of m-commerce requires an in-depth understanding of consumer behavior, significant opportunities arise not just for providers of telecommunications services, but also for companies that have a rich and thorough knowledge of consumer behavior. However, from the merchants' point of view, building m-commerce applications will present huge challenges, so companies need to leverage superior consumer insights to develop powerful branded solutions with value outside their traditional markets, particularly when forging alliances with telecommunications carriers (Nohria and Leestma, 2001).

In a value chain, each party plays its specific role and gets its own benefits. Customer service charges depend on how much value the user receives, so there will be different pricing and business models for individual services (Secker, 2001; Darling, 2001). Revenue sharing in m-commerce value chains, particularly in those of location-based services (LBS), involving mobile operators, equipment vendors and application developers, will require a significant amount of negotiation. As an example, *CT Motion* is an LBS application developer and equipment vendor, providing operators with a platform to enable deploying and managing LBS. *CT Motion* licenses its platform to operators, with an initial fee to cover basic hardware costs and licensing. Additional payments to *CT Motion* depend on the revenue stream from application users. Thus, revenue share will essentially depend on the value of the application. For example, a company delivering a car theft recovery service is doing most of the work and so it might receive 95 percent of the revenue. For a simple application, the majority of the revenue will go to the operator and the platform enabler (Secker, 2001).

In Table 3, we list the roles in an m-commerce value chain, the major players, and their corresponding sources of revenue.

**Table 3. Roles and Profit Sharing in the Value Chain**

| Role | Tasks | Major players | Sources of revenue |
|---|---|---|---|
| Equipment Supplier | Manufacturing innovative handsets and equipment | *Nokia, Ericsson, Motorola*, etc | Selling phones, equipment, or sharing revenue with network operators for discounted cell phones |
| Network Operator | Developing and maintaining infrastructure to support mobile data communication | Traditional carriers such as *Vodafone, Orange, Deutsche Telekom, AT&T* and *NTT DoCoMo* | Charges from increased network traffic |
| Service Hosting | Providing basic enabling services such as server hosting, data backup, systems integration and security control | Existing Web-hosting companies and system integrators such as *Oracle* | Shared revenue with application providers |
| Portal Provider | Offering simple, categorized information search facilities crucial to m-commerce applications. | Internet portal service providers such as *Freeserve, AirFlash, Room33, Microsoft, Yahoo, AOL Excite@Home.* | Fees charged to application carriers and advertisers |
| Billing Facilitator | Handling various sophisticated billing mechanisms such as air-time-based, user patterns-based, specific application-based, location-based, etc | Network operators such as *Vodafone, Orange, Deutsche Telekom, AT&T, NTT DoCoMo* and banks and credit card companies | Transaction fees or interest charged to merchants or consumers |
| Application Provider | Providing various end-user services such as ticket booking, e-mail checking, news scanning, and location-based services (LBSs) | Existing Internet content providers such as *Yahoo, AOL* and retail merchants (*Coca-Cola, PepsiCo, Procter & Gamble*, etc) | Revenue from customers for services or products purchased |

To help observe the maturity of the various value chain components of m-commerce outlined in Table 3, and to understand where further development must occur, it is informative to consider the inter-corporate linkages of m-commerce. This can be done according to corporate contributions to required infrastructure, associated support services, and delivery of these services to customers. To this end, we have adapted the well-known University of Texas e-commerce model of Internet Economy Indicators (Whinston et al, 2001). In their model, there are four layers (Internet infrastructure, Internet applications infrastructure, Internet intermediary, and Internet commerce). M-commerce differs significantly from e-commerce, as we have pointed out, although there is some overlap in the functional nature of both. In our m-commerce value chain model, we also propose four layers:

1) Communications Infrastructure,
2) Applications Infrastructure,
3) M-commerce Intermediary, and
4) Mobile Commerce.

Reading from the top of Table 3, the Communications Infrastructure layer includes equipment suppliers and network operators. The Applications Infrastructure includes service hosting, portal providers, and software companies that develop related software products and platforms. The M-commerce Intermediary layer includes billing facilitators, content providers, brokers, and market makers. Finally, the Mobile Commerce layer includes application providers that sell goods and services to customers.

The interconnected and interdependent nature of these four layers of the value chain cannot be over-emphasized. Thus evolution in one layer will affect the other layers. For example, advances in the communications infrastructure, such as the widespread implementation of G3, will support new developments such as wireless video and bring more potential retail applications of mobile commerce that may be both time and location sensitive. But services to support these will require further evolution in both applications infrastructure and intermediaries.

### 4.3 Active Customer Demand

What is missing from m-commerce is compelling content that will make people want to use their handsets to buy something. Consumers remain unconvinced about the wireless Web and . Uuser apathy towards wireless data services is believed to be one of the main factors delaying m-commerce implementation (Kelly, 2001). We propose that it is current narrowly-focused m-commerce applications (mainly on mobile Web systems) but not the fundamental nature of m-commerce, that frustrates consumers. The great advantage to people of eliminating fixed attachment to physical space, allows more strategic, creative, and flexible decisions and actually getting things accomplished (Kalakota and Whinston, 1996). Instead of waiting for killer applications to stimulate passive consumers, we propose that fundamental consumer demand is the active force that can improve the chance of m-commerce success.

The success of the cell phone industry has already proved the significance of this active driving force. Today there are estimated 115 million cellular phone users in the U.S. (Schooler, 2001). Of AOL's 26 million subscribers, 67% own a cell phone; 23% own a pager; 72% own a cell phone or a pager (Schultz, 2001). Market growth has been quite encouraging. Compared to the U.S, in Asia and Europe mobile telephony adoption is even more advanced (Herman, 2000). In Japan, the number of cell-phone users has already reached 66 million (Kunii, 2001). 64% of the people in Finland have a mobile phone, while the rate in Sweden stands at 55.2% (Kruger, 2000). In China, the enthusiasm for mobile phones has exceeded all forecasts, and the mobile subscriber base will probably reach 250 to 300 million in 2005, up from 68 million in 2000 (Sliwa, 2001). Recently, the population of cell phone users in China has reached 135 million, making it the world leader.

Beyond enjoying the basic service of mobile verbal communication, consumers are beginning to demand much more from their cell phones. Two-thirds of Japan's cell-phone users subscribe to one of many mobile data services offered by the country's three cellular operators. Even though the actual demands vary according to different geographical locations and demographics, consumers have played a decisive role in the success or failure of m-commerce efforts. Most potential m-commerce successes will arise from consumer demand for additional values in their daily lives, and there is unlikely to be a single killer application that can spark m-commerce success. What consumers need is an adaptable package that can accommodate various m-commerce services (personalized location-specific and time-sensitive). It is the variety of cost justification criteria adopted by consumers (in turn determined by demographics, regional cultures, current fashions, etc.) that fundamentally affect their decisions concerning specific m-commerce services. According to a *Nokia* research study that focused on m-commerce services in the U.K., South Korea, Italy, USA, Brazil and Finland, the proportion of respondents that would carry out a transaction of more than U.S. $25 using a mobile device, ranged from 24 to 54 percent (Dezoysa, 2001-1). Also, 90 per cent of all end-users surveyed that would consider using m-commerce, either now or some time in the future, would be willing to pay for its use. However, this is on the assumption that the mobile device is free. It is still uncertain whether the cost of next generation phones can be subsided by operators and, if they are not, how the added cost of paying over $150 for a mobile phone might well affect this figure (Dezoysa, 2001-1).

*DoCoMo* recently sold about 10,000 videophones at a U.S. $500 price, with service limited to Tokyo (Kunii, 2001). In Europe, the cost of providing advanced handsets equipped with high tech features is also likely to be in the neighborhood of $500 or more (Carrigan, 2001). For the additional cost of high tech handsets to be acceptable, consumers will expect to be able to access many additional services that are of value to them. In Europe, where mobile users are not charged for incoming calls, consumers can thus not only gain access to wireless services wherever there is a network presence but also keep tabs on time-critical information such as stock market reports or other urgent messages (Barnett et al. 2000). Such consumers are more likely to easily take advantage of such services.

The focus on m-commerce needs to be on delivering simple, time-sensitive, and compelling applications that do not require a lot of training. If it takes too much time (e.g. more than 5 minutes) to conduct an m-commerce transaction, it might as well be done with a PC. One example is notification about tickets to entertainment and sporting events. A consumer can contact a ticketing agency, such as *TicketMaster*, to request notification of availability of tickets for sale for an upcoming concert. When tickets meeting the consumer's criteria become available, *TicketMaster* sends a message to the consumer's wireless device and asks if the consumer wants to buy them or not, It is a simple yes-or-no transaction (Lucas, 2001). Any applications that require consumers to input much information will not work either, because of keyboard limitations. For example, a visit to *Barnes & Noble*'s WAP site to enter credit card number, address, and shipping information requires more than 100 keystrokes (Swartz, 2001-2).

### 4.4 Synergy of three driving forces

The success of m-commerce relies on the synergy of three driving forces: technology innovation, value chain evolution and active customer demand. Technology innovation provides more useful functions with lower prices, creating value for customers and stimulating customer demand. Technology innovation also demands high-level collaboration through the value chain. Active customer demand provides rich revenue sources to value chain and stimulates technology innovation and the development of new applications. Value chain evolution ensures the collaboration of multiple parties through appropriate profit sharing, which in turn supports more technology innovation. Through positive interaction loops the three driving forces will eventually contribute to the success of m-commerce. This synergy is graphically illustrated in Figure 1.

<Place Figure 1 about here>

## 5. Conclusions

Are we ready for m-commerce? Differing perspectives of m-commerce will lead us to opposite answers. But our research into the nature of m-commerce shows that m-commerce applications are fundamentally different from those delivered in the Internet-based e-commerce environment. Simply transforming e-commerce services to cell phones or PDAs will merely expose the limitations of wireless handhelds and result in frustrating end-user experiences. Therefore, as we examine any any speculation about m-commerce applications, we must attempt to exploiting the unique features of mobile devices as well as to avoid their weaknesses. Furthermore, the eventual success of any m-commerce strategy depends on the synergy of the three driving forces we have identified: technology innovation, value chain evolution, and active customer demand.

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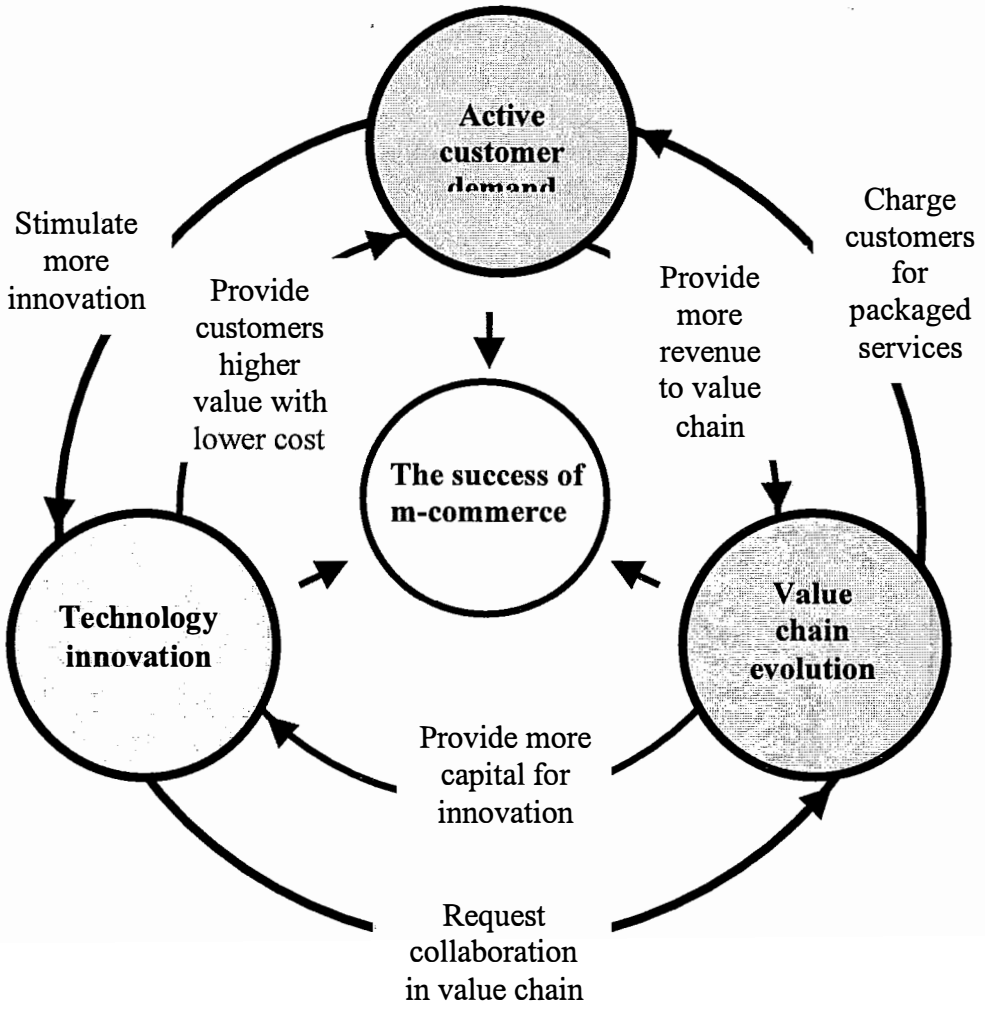


**Figure 1. The synergy of three driving forces for m-commerce success**

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